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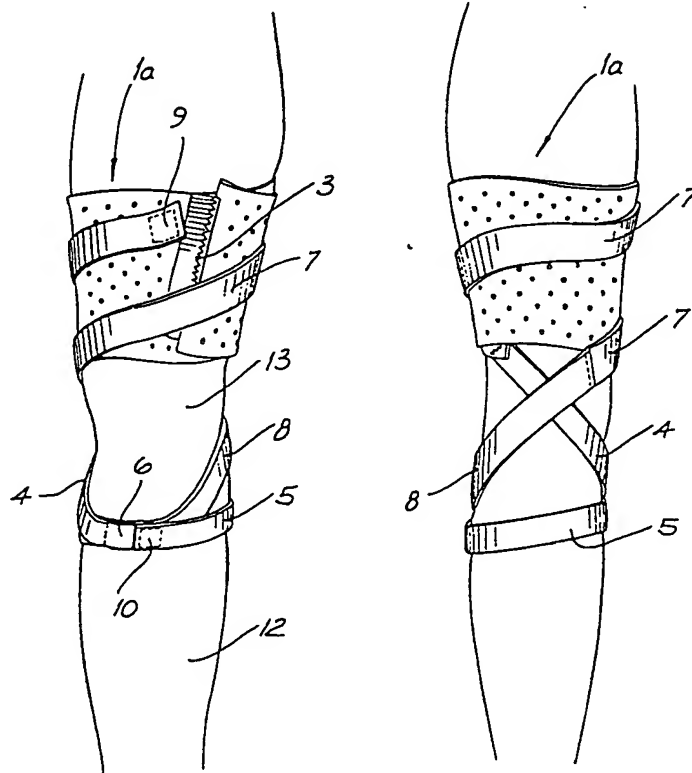
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(54) Title: KNEE BRACE

(57) Abstract

This invention provides a knee brace for restraining tibial rotation and translation for a person having anterior cruciate ligament instability. The brace comprises a thigh wrap (1a), a garter (5), and a pair of de-rotation straps (8, 4), which cross behind the knee and are attached to the thigh wrap and garter. The brace is soft, lightweight, and portable, and allows the person to participate in contact sport without presenting a danger of injury to other players and without significantly reducing the person's speed and agility. In compliance with recommended practice, it provides increasing restraint to tibial translation with increasing knee extension.



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KNEE BRACETECHNICAL FIELD

The present invention relates to knee braces and, more particularly, to a soft, lightweight knee brace for restraining tibial rotation and translation in a patient
5 having anterior cruciate ligament instability.

BACKGROUND ART

Knee braces are used often to assist patients with anterior cruciate ligament instability. In general, conventional braces use fairly rigid members and hinges to
10 form frameworks for attachment of stabilizing straps. However, such members and hinges are usually made from hard materials and therefore, when worn by a player engaging in a contact sport, can constitute a danger to other players.

15 In addition, such members and hinges add bulk, weight, and hardness to the brace, and, when used in contact sports, require internal and external padding. These factors can reduce the speed and agility of a player, and make the braces inconvenient to carry when
20 they are not in use.

Hinges also tend to constrain the axis of flexion of the knee, and are difficult to apply in such a way that they are positioned correctly with their axes of flexion coinciding substantially with anatomical axes. Incorrect
25 positioning of the hinge axis or axes probably pre-stresses the knee, and may cause varus or valgus deformation. Even if conventional braces are applied correctly, they may slip to incorrect positions during wear. To reduce the probability of slippage to incorrect
30 positions, braces generally need to be applied tightly. This often causes them to be uncomfortable.

It is generally believed that anterior cruciate }
instability is a functional problem when the knee is }
stressed in the last 30 degrees of extension.

35 In view of the above, it is desirable to provide a

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knee brace made from a soft material which, when worn by a player engaging in a contact sport, will not constitute a danger to other players.

It is further desirable to provide a knee brace which
5 is small and lightweight, such that it does not substantially reduce the speed and agility of the person playing sport, and such that it can be rolled into a pocket-sized package which is convenient to carry when it is not being worn.

10 It is yet further desirable to provide a knee brace, having medial and lateral de-rotation straps following the same principles as extra-articular reconstructions for anterior cruciate instability as have been used surgically in the past, which avoids problems associated with
15 alignment of anatomical and hinge axes. Such a knee brace should have little tendency to slip, and should be comfortable.

It is yet further desirable to provide a knee brace which offers increasing restraint to tibial translation as
20 the knee approaches full extension.

DISCLOSURE OF INVENTION

The present invention consists in a brace for restraining tibial rotation and anterior translation in a leg of a patient, the brace comprising:

- 25 a thigh wrap made from a flexible, resilient, substantially non-slip material, the thigh wrap being adapted to be secured around the thigh of the patient, thereby defining a medial side of the thigh wrap and a lateral side of the thigh
30 wrap;
a garter adapted to be secured around the leg immediately below the knee of the patient, thereby defining a medial side of the garter and a lateral side of the garter;
35 a lateral de-rotation strap having a first end

adapted to be connected, or connectable, to the thigh wrap, and a second end adapted to be connected, or connectable, to the garter, such that the lateral de-rotation strap extends from the lateral side of the garter to the medial side of the thigh wrap when the patient is using the brace; and

5 a medial de-rotation strap having a first end adapted to be connected, or connectable, to the thigh wrap, and a second end adapted to be connected, or connectable, to the garter, such that the medial de-rotation strap extends from the medial side of the garter to the lateral side of the thigh wrap when the patient is using the brace;

15 whereby, when the patient is using the brace, the medial de-rotation strap and the lateral de-rotation strap cross behind the knee of the patient and act on the garter to provide a lateral de-rotation force, a medial de-rotation force, and a posterior force to the tibia.

20 Preferably, the medial de-rotation strap, the lateral de-rotation strap, and a reinforced section of the garter are formed from a single elongate strap adapted to be wound around the leg of the patient.

25 Preferably, the elongate strap has a first end attached to, or being an extension of, the thigh wrap, and a second end having attachment means for attaching the second end to the thigh wrap, the medial de-rotation section being adjacent the thigh wrap.

30 Preferably, the reinforced section of the garter is positioned between the medial de-rotation section and the lateral de-rotation section, the reinforced section being adapted to be positioned below, and in front of, the knee.

Preferably, the thigh wrap comprises a neoprene base

and a soft, fibrous layer laminated onto, or otherwise attached to, the neoprene base.

Preferably, the thigh wrap is perforated to allow perspiration to escape.

5 Preferably, the thigh wrap includes fastening means for securing the thigh wrap around the thigh.

Preferably, the fastening means for securing the thigh wrap around the thigh comprises a strip of hook and eye fastening material, such as that sold under the
10 registered trade mark Velcro, which can engage with the soft, fibrous layer.

Preferably, the garter further comprises a garter strap including securing means for securing the garter strap around the leg.

15 Preferably, the securing means comprises a strip of hook and eye fastening material which can engage with the soft, fibrous layer.

BRIEF DESCRIPTION OF DRAWINGS

A preferred embodiment of the invention will be
20 described with reference to the accompanying figures in which:

Fig. 1 is a perspective view of a left-leg version of a knee brace according to a preferred embodiment of the present invention;

25 Fig. 2 is a side elevation of the knee brace of Fig. 1;

Fig. 3 is a front view of the knee brace of Fig. 1 being worn on a left leg;

Fig. 4 is a rear view of the knee brace of Fig. 1
30 being worn on a left leg;

Fig. 5 is a medial view of the knee brace of Fig. 1 being worn on a left leg; and

Fig. 6 is a lateral view of the knee brace of Fig. 1 being worn on a left leg.

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BEST MODE FOR CARRYING OUT THE INVENTION

Referring to Figs. 1 and 2, the preferred embodiment of the present invention comprises thigh wrap 1a; an elongate strap comprising medial de-rotation section 4, reinforced section 6, lateral de-rotation section 8, and helical wrap 7; and garter strap 5.

Thigh wrap 1a comprises a flexible, elastic, substantially non-slip base 1, onto which is laminated, or otherwise attached, soft fibrous layer 2. Preferably, base 1 is made from high quality 3mm neoprene, and layer 2 is made from one-way stretch velour fabric. Thigh wrap 1a is wrapped around the patient's thigh with base 1 in contact with the patient's skin. Preferably, thigh wrap 1 is perforated with holes 11 to allow perspiration to escape. Fastening means 3, which could be made from a strip of hook and eye fastening material, such as that sold under the registered trade mark Velcro, is attached to a first end of thigh wrap 1a such that it can engage with fibrous layer 2 to secure thigh wrap 1 to the patient's thigh.

As illustrated in Fig. 4, medial de-rotation section 4 can be attached obliquely to a second end of thigh wrap 1a, and thigh wrap 1a is positioned in such an orientation on the patient's leg that medial de-rotation section 4 projects down from above knee 13 on the lateral side of the leg, passes diagonally across the back of the knee, and continues around the medial side of the leg, below the knee. Medial de-rotation section 4 preferably comprises a reinforced double layer of material to form a relatively strong, inelastic section.

As medial de-rotation section 4 emerges below and on the medial side of knee 13, it joins a first end of reinforced section 6. As shown in Fig. 3, reinforced section 6 is positioned below the knee and below the level of insertion of the pes anserinus tendons and the tibial

tuberosity. Preferably, reinforced section 6 comprises a triple layer of material to form a strong, relatively inelastic section which can restrain anterior translation of the tibia.

5 As illustrated in Figs. 1 and 2, lateral de-rotation section 8 joins a second end of reinforced section 6.

Referring to Fig 6, lateral de-rotation section 8 passes from below the knee on the lateral side of the leg, up and diagonally across to the medial side of the knee,
10 crossing medial de-rotation section 4, to join a first end of helical wrap 7. Lateral de-rotation section 8 preferably comprises a reinforced double layer of material to form a strong relatively inelastic section.

Helical wrap 7 emerges from the medial side of the
15 leg above the knee, and continues to wrap around the thigh. The second end of helical wrap 7 is provided with attachment means 9 for attaching that second end to soft fibrous layer 2 of thigh wrap 1a. Attachment means 9 preferably comprises a strip of hook and eye fastening
20 material.

Preferably, the layers of medial de-rotation section 4, reinforced section 6, and lateral de-rotation section 8, are made from the same materials as thigh wrap 1a, and are sewn together with stitches of a strong durable thread
25 such as braided nylon or polyester.

30 Garter strap 5 is wrapped around the back of knee 13 and is attached to reinforced section 6 so that the garter comprising garter strap 5 and reinforced section 6 provides a firm, substantially non-slip anchor from which the de-rotation straps can apply lateral de-rotation forces, medial de-rotation forces, and posterior forces to the tibia, without causing reinforced section 6 to slip up the leg.

The medial and lateral forces provided to the tibia
35 by medial de-rotation section 4 and lateral de-rotation

section 8 restrain the tibia from rotating. In addition, the posterior force provided by these de-rotation sections restrains anterior translation of the tibia.

In the preferred embodiment, thigh wrap 1a consists of a rectangular laminated sheet with dimensions 22cm by 52cm, the elongate strap has dimensions 55cm by 5cm, and the garter strap is attached to the elongate strap at a point 12cm to 13cm from the point of attachment of the medial de-rotation section to the thigh wrap.

10 When fitting the knee brace, the patient's knee is preferably placed in approximately 90 degrees of flexion. Reinforced section 6 is applied to the leg at the level of insertion of the pes anserinus tendons. Medial de-rotation section 4 and lateral de-rotation section 8 are placed such that they lie antero-medially and antero-laterally. Garter 5 is fastened below the knee. Then, thigh wrap 1a is applied to the thigh while keeping medial de-rotation section 4 under tension, and ensuring that thigh wrap 1a does not interfere with the patella
15 when the knee is taken into full extension. Finally, the leg is fully externally rotated, lateral de-rotation section 8 is wrapped under tension around the leg, and helical wrap 7 is wound under tension around, and attached to, thigh wrap 1a.

25 It is necessary that the knee brace provide considerable resistance to full active knee extension. If there is very little resistance to active knee extension, then the posterior force on the proximal tibia applied by the de-rotation sections will probably be inadequate to stabilize the knee during sporting activity.

Intermittently during use, the user should ensure that the brace is sufficiently tight and is correctly positioned.

In the above, only a left-leg version of the knee
35 brace has been described. However, a right-leg version is

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provided in an exactly analogous manner.

Thus, the invention provides a lightweight, compact knee brace. The knee brace can be worn by players engaging in contact sports, without fear of injuring other
5 players, and with only slight limitation of the player's speed and agility.

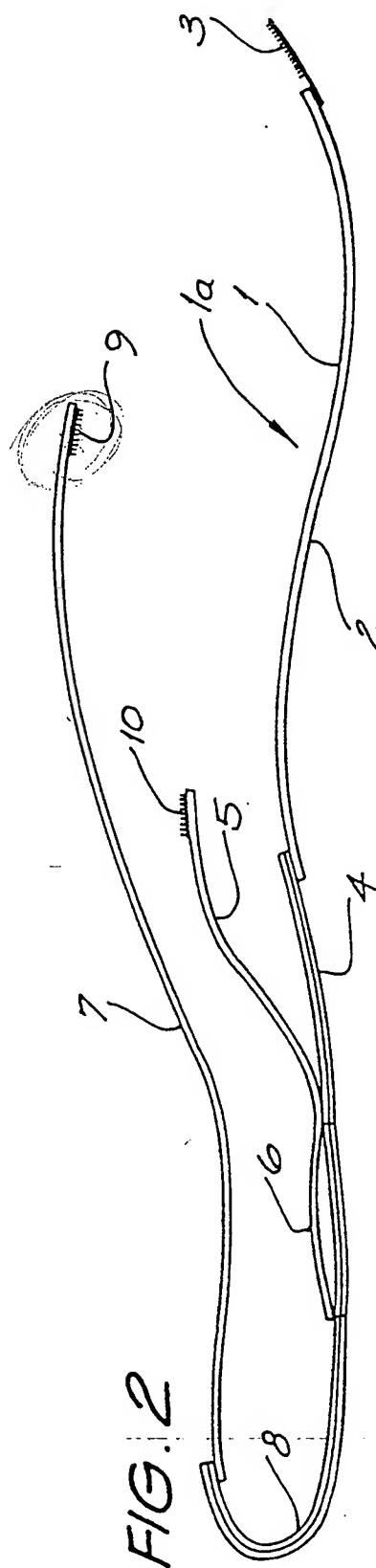
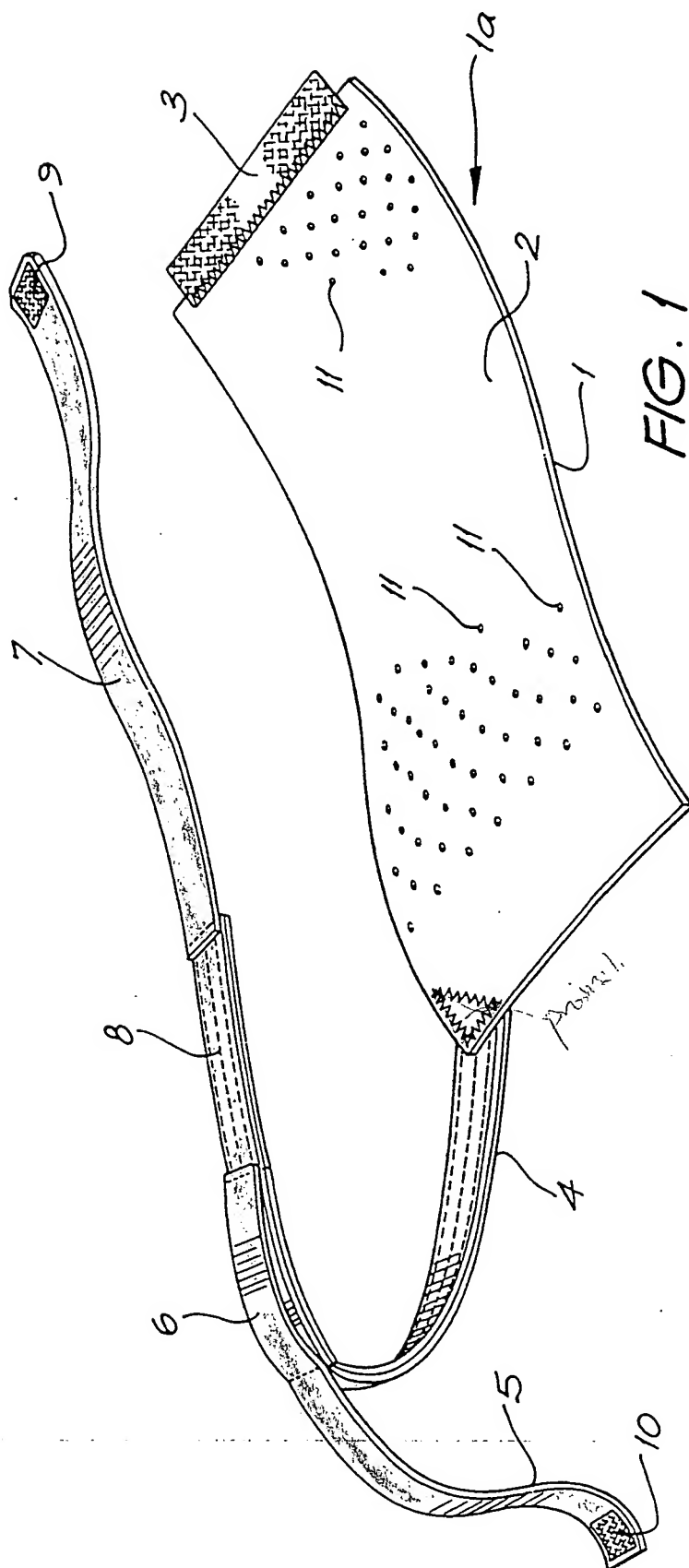
Persons skilled in the art will appreciate that numerous variations or modifications may be made to the invention as shown in the specific embodiments without
10 departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

CLAIMS

1. A brace for restraining tibial rotation and anterior translation in a leg of a patient, the brace comprising:
- 5 a thigh wrap made from a flexible, resilient, substantially non-slip material, the thigh wrap being adapted to be secured around the thigh of the patient, thereby defining a medial side of the thigh wrap and a lateral side of the thigh wrap;
 - 10 a garter adapted to be secured around the leg immediately below the knee of the patient, thereby defining a medial side of the garter and a lateral side of the garter;
 - 15 a lateral de-rotation strap having a first end adapted to be connected, or connectable, to the thigh wrap, and a second end adapted to be connected, or connectable, to the garter, such that the lateral de-rotation strap extends from the lateral side of the garter to the medial side of the thigh wrap when the patient is using the brace; and
 - 20 a medial de-rotation strap having a first end adapted to be connected, or connectable, to the thigh wrap, and a second end adapted to be connected, or connectable, to the garter, such that the medial de-rotation strap extends from the medial side of the garter to the lateral side of the thigh wrap when the patient is using the brace;
 - 25 whereby, when the patient is using the brace, the medial de-rotation strap and the lateral de-rotation strap cross behind the knee of the patient and act on the garter to provide a lateral de-rotation force, a medial de-rotation force, and a posterior force to the tibia.
 - 30
2. The brace according to claim 1 wherein the medial

de-rotation strap, the lateral de-rotation strap, and a reinforced section of the garter are formed from a single elongate strap adapted to be wound around the leg of the patient.

- 5 3. The brace according to claim 2 wherein the elongate strap has a first end attached to, or being an extension of, the thigh wrap, and a second end having attachment means for attaching the second end to the thigh wrap, the medial de-rotation section being adjacent the thigh wrap.
- 10 4. The brace according to claim 2 wherein the reinforced section of the garter is positioned between the medial de-rotation section and the lateral de-rotation section, the reinforced section being adapted to be positioned below, and in front of, the knee.
- 15 5. The brace according to any one of claims 1 to 4 wherein the thigh wrap comprises a neoprene base and a soft, fibrous layer laminated onto, or otherwise attached to, the neoprene base.
- 20 6. The brace according to any one of claims 1 to 5 wherein the thigh wrap is perforated to allow perspiration to escape.
7. The brace according to any one of claims 1 to 6 wherein the thigh wrap includes fastening means for securing the thigh wrap around the thigh.
- 25 8. The brace according to claim 7 wherein the fastening means for securing the thigh wrap around the thigh comprises a strip of hook and eye fastening material which can engage with the soft, fibrous layer.
- 30 9. The brace according to any one of claims 1 to 8 wherein the garter comprises a garter strap including securing means for securing the garter strap around the leg.
- 35 10. The brace according to claim 9 wherein the securing means comprises a strip of hook and eye fastening material which can engage with the soft, fibrous layer.

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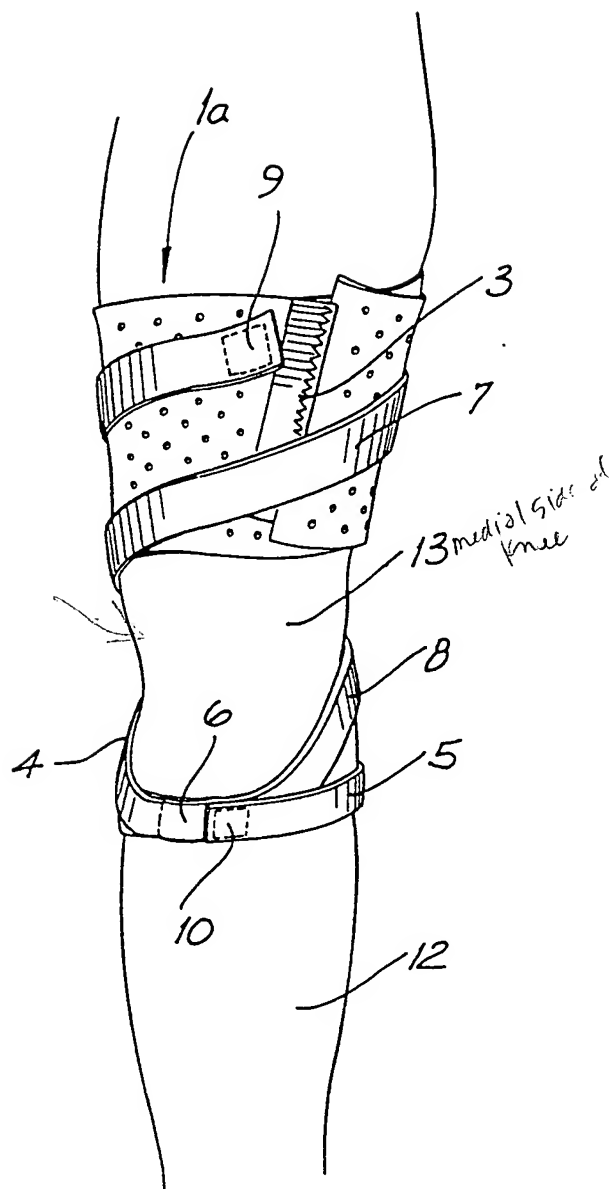


FIG. 3

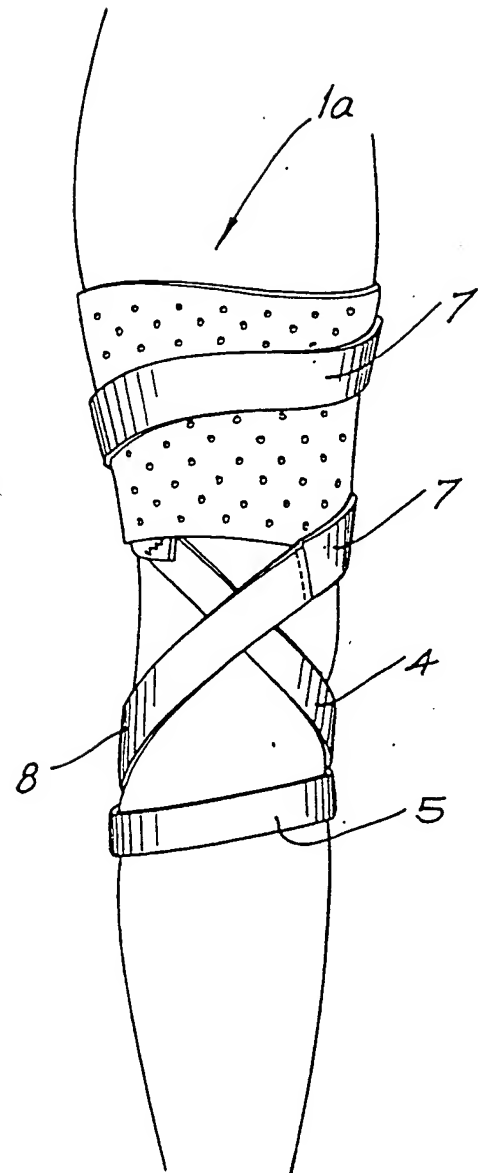


FIG. 4

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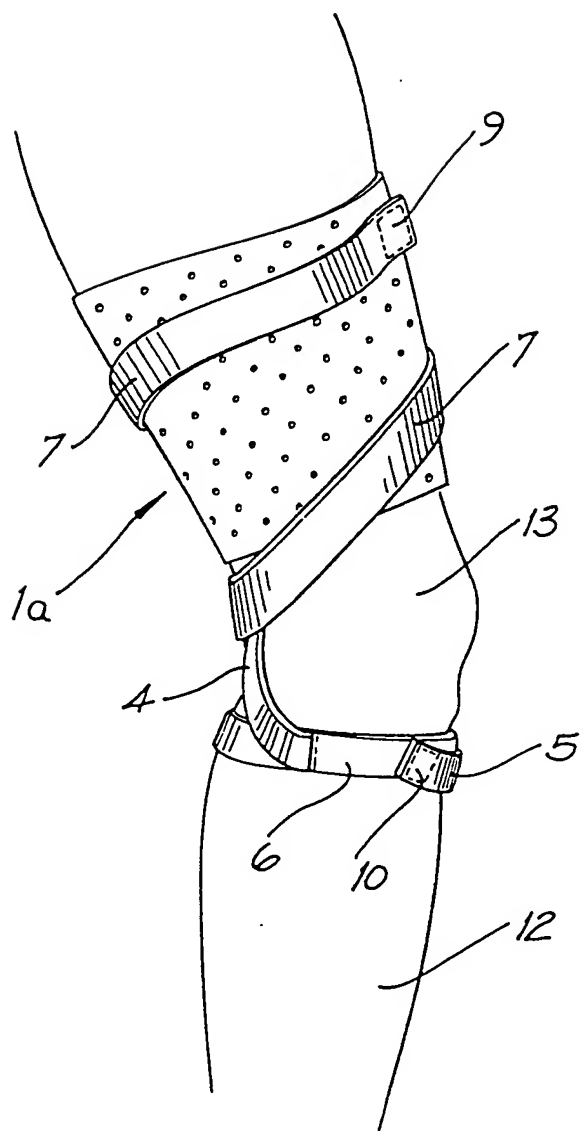


FIG. 5

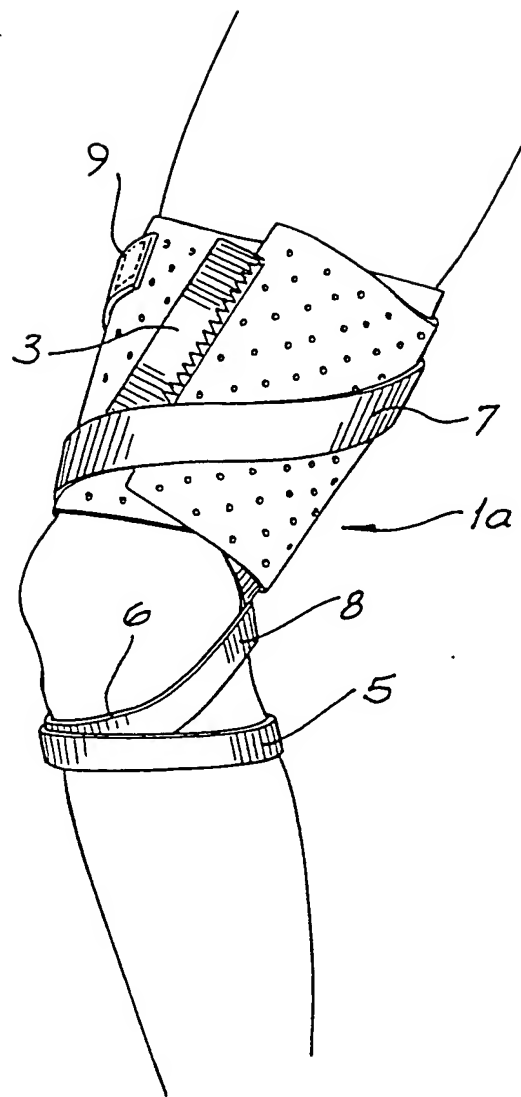


FIG. 6